





# **CERTIFICATE OF APPRECIATION**

Number: I-2817/InCASST/DIES30/FST/X/2023

This certificate is presented to

## Iwan Binanto and Andrianto Tumanggor

### Author of the Paper Entitled:

Comparison of the K-Means Method with and without Principal Component Analysis (PCA) in Predicting Employee Resignation

In gratitude for outstanding contribution to

### International Conference on Applied Sciences and Technologies (InCASST)

organized by Faculty of Science and Technology, Sanata Dharma University Yogyakarta-Indonesia, October 18, 2023.



Ir. Drs. Haris Sriwindono, M.Kom. Ph.D. Dean of Faculty of Science and Technology, Sanata Dharma University





International Conference on Applied Sciences and Smart Technologies



303 303 303

# ROGRAM BOOK & ABSTRACTS

# INTERNATIONAL CONFERENCE ON APPLIED SCIENCES AND SMART TECHNOLOGIES

SCIENCE AND TECHNOLOGY DISRUPTION IN THE POST PANDEMIC ERA FOR BETTER LIFE QUALITY

ORGANIZED BY FACULTY OF SCIENCE AND TECHNOLOGY SANATA DHARMA UNIVERSITY

> October 18, 2023 YogyaKarta, Indonesia

> > CO-HOST







E B E C E C E

### TABLE OF CONTENTS

MESSAGE FROM DEAN's	iii
THE COMMITTEES	iv
KEYNOTE SPEAKERS	v
SCHEDULE PROGRAM	vii
DETAILED PRESENTATION SESSION	ix
TABLE OF PAPERS	
ABSTRACT FROM KEYNOTE SPEAKERS	
ABSTRACT FOR PARALLEL SESSIONS	



### **MESSAGE FROM DEAN'S**

Dear participants,

First of all, all praise and gratitude should go to God Almighty for His blessings, the first international conference organized by the Faculty of Science and Technology of Sanata Dharma University can be held.

It is with pride and pleasure that I welcome you all to this special event, the International Conference on Applied Sciences and Smart Technologies (InCASST 2023). This International Conference organized by the Faculty of Science and Technology of Sanata Dharma University is not just an ordinary conference, but also a milestone to celebrate our thirty years of service in the field of education, knowledge, research, and innovation at the Faculty of Science and Technology of Sanata Dharma University.

For three decades, we have witnessed tremendous growth in the field of science and technology, and we have been involved in it. We have witnessed our lecturers conducting deep research and advancing the frontiers of knowledge. We have witnessed cross-country collaborations that connect us to the global scientific community.

This conference is a pivotal moment in our journey. It is a platform for thinkers, researchers and innovators from around the world to come together, share and inspire one another. Our conference theme, "Disrupting Science and Technology in the Post-Pandemic Era with Sustainable Development for a Better Quality of Life" reflects our determination to continue pushing the boundaries of knowledge, facing future challenges, and creating sustainable solutions.

This program book contains a summary of the events that will take place during the conference, a list of prominent speakers, and other important information. It is your guide to everything that will happen during the conference.

I would like to thank Prof. Tokuro Matsuo, Prof. Sudi Mungkasi, Ph.D., Assoc. Prof. Dr. Peerapong Uthansakul and Assist. Prof. Rando Tungga Dewa, for sharing as keynote speakers in this conference. I would also like to thank all the speakers who came from different parts of the world, who have been willing to share their knowledge with us.

I would also like to thank all those who have contributed in making this conference a reality. Thank you to the organizers who have worked hard to prepare this event carefully.

We believe that this conference will be a platform to build new collaborative networks, stimulate innovative ideas, and deepen our understanding of global challenges that require scientific solutions. Together, we will illuminate the path to a better and brighter future.

Warm greetings from us at Sanata Dharma University, Yogyakarta. May this conference be a fulfilling and rewarding scientific experience for all participants.

Thank you very much.

Ir. Drs. Haris Sriwindono, M.Kom., Ph.D. Dean of Faculty of Science and Technology, Sanata Dharma University





### THE COMMITTEES

### **Advisory board**

- Prof. Dr. Willy Susilo (Wollongong University, Australia)
- Apichate Maneewong, Ph.D. (Institute of Nuclear Technology, Thailand)
- Pham Nhu Viet Ha (Vietnam Atomic Energy Institute, Vietnam)
- Dr. rer. nat. Wolfgang Bock (Department of Mathematics, Rheinland-Pfalz Technical University, Germany)
- Dr. Bambang Dwi Wijanarko, S. Si, M.Kom. (Universitas Bina Nusantara, Semarang, Indonesia)
- Dr. Ir. Feri Yusivar, M.Eng (Universitas Indonesia, Indonesia)
- Dr. Irma Saraswati, M.Sc. (Universitas Sultan Ageng Tirtayasa, Indonesia)
- Dr. Imamul Muttakin (Universitas Sultan Ageng Tirtayasa, Indonesia)
- Dyonisius Dony Ariananda, S.T., M.Sc., Ph.D. (Universitas Gadjah Mada, Indonesia)
- Dr. Ir. Ford Lumban Gaol, S.Si., M.Kom. (Universitas Bina Nusantara, Indonesia)

### **Steering Committee**

- Conference Chairperson: Ir. Drs. Haris Sriwindono, M.Kom, Ph.D. (Sanata Dharma University Indonesia)
- Conference Co-chair
   Ir. Damar Widjaja, Ph.D (Sanata Dharma University Indonesia)
- 🔍 🛛 Member
  - o Dr. lr. l Gusti Ketut Puja (Sanata Dharma University Indonesia)
  - Prof. Frans Susilo, SJ, (Sanata Dharma University Indonesia)

•

:

o Prof. Ir. Sudi Mungkasi, Ph.D (Sanata Dharma University - Indonesia)

#### **Organizing Committee**

- Conference chair : Dr
- : Dr. Ir. Bernadeta Wuri Harini (Sanata Dharma University Indonesia)
- Conference co-chair : Dr. Eng. I Made Wicaksana Ekaputra (Sanata Dharma University -Indonesia)
  - Member
    - o Ir. Theresia Prima Ari Setiyani, M.T. (Sanata Dharma University Indonesia)
    - o Ir. Augustinus Bayu Primawan, D.Tech.Sc. (Sanata Dharma University Indonesia)
    - o Regina Chelinia Erianda Putri, M.T. (Sanata Dharma University Indonesia)
    - Stefan Mardikus, M.T. (Sanata Dharma University Indonesia)
    - Rosalia Arum Kumalasanti, M.T. (Sanata Dharma University Indonesia)
    - o Dr. Ir. Ridowati Gunawan, S.Kom., M.T. (Sanata Dharma University-Indonesia)



### **KEYNOTE SPEAKERS**



### Prof. Ir. Sudi Mungkasi, Ph.D. (Sanata Dharma University-Indonesia)

Prof. Ir. Sudi Mungkasi is a full professor at the Department of Mathematics, Faculty of Science and Technology, Sanata Dharma University, Yogyakarta, Indonesia. He obtained the degree of Sarjana Sains (S.Si.) in Mathematics from Gadjah Mada University, Yogyakarta, Indonesia in 2004. He received the degrees of Master of Mathematical Sciences (M.Math.Sc.) and Doctor of Philosophy (Ph.D.) in Mathematical Sciences from The Australian National University, Canberra, Australia in 2008 and 2013, respectively. He was a postdoctoral fellow at the Mathematical Sciences Institute of The Australian National University in 2013. The professional degree of Insinyur (Ir.) in Engineering Sciences was obtained from Sanata Dharma University in 2021. His research interests include applied and computational mathematics as well as modelling and simulation for physical, biological, chemical, and engineering problems. Currently, he serves as Vice Rector for Academic Affairs of Sanata Dharma University.



Prof. Tokuro Matsuo is currently a Full Professor (tenured) at the Advanced Institute of Industrial Technology (AIIT) in Public University Corporation Tokyo Metropolitan University since 2012. Also, he is currently a Director of the Research Center for Artificial Intelligence and Service Science at AIIT and CEO of the International Institute of Applied Informatics (IIAI). His current research interests include agent-based electronic commerce, qualitative reasoning and simulation, material informatics, IT and business management, and IoT. He delivered 150 keynotes and invited talks at international conferences, symposia, and seminars in this decade. He also received over 10 awards on research and over 30 research grants from the government, research foundations, and companies.





### Assoc. Prof. Dr. Peerapong Uthansakul (Suranaree University of Technology-Thailand)

Peerapong Uthansakul has been working as the Associate Professor at the School of Telecommunication Engineering and the Director of the Institute of Research and Development, Suranaree University of Technology, Thailand. He has got more than one hundred research publications and is the author/co-author of various books related to MIMO technologies. Furthermore, he is the editor of "Suranaree Journal of Science and Technology" and other leading Thai journals related to Science and Technology. He has won various national awards from the government of Thailand due to his contributions and motivation in the field of Science and Technology. His research interests include green communications, wave propagation modeling, MIMO, Massive MIMO, Brain Wave Engineering, OFDM and advanced wireless communications, wireless sensor network, embedded systems, the internet of things, and network security. His current research interest is in Artificial Intelligence and Bio-Signal studies.



Dr. Eng. Rando Tungga Dewa focuses on the fracture mechanics field in advanced technology. He is an Assistant Professor in the Mechanical Engineering Department, RIDU (The Republic of Indonesia Defense University). He has done some research topics including Nuclear Reactor Gen-IV design, vibration fatigue on structures, and advanced additive manufacturing technologies on energetic materials. He, at least published more than 20 peer-reviewed articles and attended 50 symposiums with H-index 8



### SCHEDULE PROGRAM

- 1. InCaSST October 18, 2023 07.30 AM, Eastparc Hotel.
- 2. Gala Dinner October 18, 2023 06.00 PM, Eastparc Hotel.

### Detailed Conference Program Wednesday, 18<sup>th</sup> October, 2023 (Time based: Jakarta, Indonesia GMT+7)

Time	Event	Room
07.30 - 08.00	Registration and Welcome Drink	
08.00 - 08.15	Opening Ceremony	
08.15 – 08.30	Greeting Speech	
08.30 – 08.45	Traditional Dance Performance	
08.45 - 10.35	Keynote Speakers Session:	Garden Room
	1. Prof. Tokuro Matsuo 🥏	
	2. Asst. Prof. Dr. Eng. Rando Tungga Dewa	
	3. Prof. Ir. Sudi Mungkasi, Ph.D.	
	4. Assoc. Prof. Dr. Peerapong Uthansakul	
10-35 - 10.50	Parallel Session Preparation	
10.50 - 12.00	Parallel Session 1	Room 1: Orchid Room
		Room 2: Magnolia Room
		(3 <sup>rd</sup> floor)
12.00 - 13.00	Lunch	Restaurant
13.00 - 14.40	Parallel Session 2	Room 1: Orchid Room
		Room 2: Magnolia Room
		(3 <sup>rd</sup> floor)
14.40 - 15.00	Coffee Break	
15.00 - 16.10	Parallel Session 3	Room 1: Orchid Room
		Room 2: Magnolia Room
		(3 <sup>rd</sup> floor)



#### Detailed Gala Dinner Agenda Wednesday, 18<sup>th</sup> October, 2023 (Time based: Jakarta, Indonesia GMT+7)

#### Place: Garden Room





### **DETAILED PRESENTATION SESSION**

Time based: Jakarta, Indonesia GMT+7

KEYNOTE SPEAKER SESSION				
08.45-10.35 WIB				
Mod	erator: Hartono, Ph.D			
Rc	oom: Garden Room			
Prof. Tokuro Matsuo 🛛 👝	Towards Smart Applied Sciences with Multiple Sensors			
Asst. Prof. Dr. Eng. Rando	Research and Development at RIDU: Technological			
Tungga Dewa	Resources for <mark>De</mark> fense Equipment			
	Q&A			
Prof. Ir. Sudi Mungkasi, Ph.D. 🔪	Roles of Mathematics in Disaster Mitigations			
Assoc. Prof. Dr. Peerapong	Feasibility Study of Brainwave Communications in the			
Uthansakul 🧹 💦 🔪	Post Pandemic Era: EEG Signals for Writing Imagination			
	Q&A			



	PARALLEL SESSION 1.1.	
	10.50 – 12.00 WIB	
	Room 1: Orchid Room	
	Moderator: A. Prasetyadi, M.Si., Ph.D.	
	<b>Topic :</b> Clean Energy and Green Technologies	
2674	Transparent Carbon Capture and Storage using Blockchain Technology	10'
2628	Effect of Curing Temperature on The Mechanical Properties of Coconut Shell Nano	
	Carbon Reinforced Composites with Epoxy Matrix	10'
2655	The Role of Nanocatalyst of Pearl Oyster Shell in Pack Carburizing Process on	
	Mechanical and Physical Properties of AISI 1020 Steel	10'
2825	Investigation of Eichhorn <mark>ia c</mark> rassipes as a natural fibre in PMC for noise controller	10'
2840	Exploring The Potential of Go-Based Composite Hydrogels and Their Swelling	
	Property for Controlled Drug Delivery	10'
2899	Alternative Method for Stop The Coconut Shell Charcoal Briquette Drying Process	10'
2889	The Effect of Chassis Weight Optimization on The Carbon Footprint of The Electric	
	Prototype Vehicle	10'

PARALLEL	SESSION 1.2.
10.50 -	12.00 WIB

Room 2 : Magnolia Room

Moderator: Dr. Adinda Ihsani Putri

Το	nic ·	W/aste	Manad	ement	and	Recv	cling
IU	<b>JIC</b> .	vvasic	Ivialia	CHICHL	anu	NECY	CIIIIg

2671	Utilization of Used Oil Waste for Boiler Energy Source	10'	
2625	Readiness Assessment of Lean Six Sigma Implementation in Manufacturing		
	Industry as A Way To Ensure Sustainability	10'	
2659	Modelling study of boiler using oil waste as an energy source	10'	
2681	SCADA for Waste Sorting System as an Environmental Conservation Effort	10'	
2687	Antibacterial Properties of Enzymatically Treated PET Fibers Functionalized by		
	Nitric Oxide	10'	
2843	Design And Feasibility Study of Mobile Biodigester for Military Operation	10'	
2877	Optimization of pyrolysis of polypropylene and polyethylene based plastic waste		
	become an alternative fuel oil using bentonite catalyst	10'	



PARALLEL SESSION 2.1			
13.00 - 14.40 W/B			
	Poom 1 : Orshid Poom	_	
	wioderator: Dr. Achilleus Hermawan Astyanto		
-	<b>Topic :</b> Renewable Energy Technologies and Systems	l	
2661	An Overview of Wind Energy to Optimize Initial Potential in Java	10'	
2666	Solar Power Control System on Smart Green Home	10'	
2663	Numerical Investigation on the Effect of Blunt Body Deflector on Darieus Turbine		
	Performance	10'	
2773	Using A Stepper Motor as A Low-Power, Low-Rotation DC Generator for Renewable		
	Energy Harvesting	10'	
2786	Design And Implementation of A 232.2 KWP Rooftop and on Grid Solar Power Plant	10'	
2812	An experimental investigation on CCFL characteristics during gas/low surface		
	tension liquid counter-current two-phase flow in a small-scaling PWR hot leg typical		
	geometry	10'	
2830	Techno-Economic Analysis of Hybrid PV-Battery-Diesel System for Isolated		
	Dockyard in West Papua	10'	
2876	Machine Learning Based Modelling for Estimating Solar Power Generation	10'	
2816	Aerodynamic Analysis of a Windmill Water Pump using Blade Element Momentum		
	Theory (2816)	10'	
2983	Coefficient of Power of Indonesian Traditional Wind Pump Blade Model (2983)	10′	

### PARALLEL SESSION 2.2.

#### 13.00 – 14.40 WIB

### Room 2 : Magnolia Room

Moderator: Ir. Augustinus Bayu Primawan, D.Tech.Sc.

**Topic** : Environmental Impact Assessment and Management

2680	Fast fashion Revolution: Unveiling the Path to Sustainable Style in the Era of Fast	
	fashion	10'
2344	The Impact Assessment of Automated Drip Infusion Control Using Weighing Scale	
	and Pinch Method on Subjects	10'
2635	Analysis of Coal Facies and Parting in The Balikpapan Formation, Kutai Basin, East	
	Kalimantan	10'
2637	Distribution Model, Depositional Environment, and Facies Of Coal in the AE field,	
	Kutai Kartanegara area, East Kalimantan	10'
2682	A Method for Assessing Green Value Chain Readiness	10'
2779	Study of Population Distribution and Benefits of Nipah (Nypa fruticans)	10'
2795	Development of Digital Livestock Monitoring in Sambilawang Village, Serang,	
	Banten	10'
2817	Comparison of the K-Means Method with and without Principal Component	
	Analysis (PCA) in Predicting Employee Resignation	10'
2844	The Key Impact Factors of Visitors' Environmentally Responsible Behaviour at	
	Mlarangan Asri Beach Kulon Progo Regency	10'
2878	Environmental Management for Car Accident Precaution and Remote Notification	10'



PARALLEL SESSION 3.1.			
	15.00 – 16.10 WIB		
	Room 1 : Orchid Room		
	Moderator: Dr. rer. nat. Herry Pribawanto Suryawan		
	<b>Topic :</b> Environmental Impact Assessment and Management		
2905	Replication Control Strategy Based on A Simple Game of Life in Opportunistic		
	Mobile Networks	10'	
2019	Gamification Design for Tourism Mobile Applications Temple	10′	
2879	Fall Detection and Notification System to Fast Emergency Management for the		
	Elderly	10'	
2883	Classification of Delivery Types of Pregnant Women Using Support Vector Machine	10'	
2885	A Study of Stochastic Epidemic Model Driven by Liouville Fractional Brownian		
	Motion Coupled with Seasonal Air Pollution	10'	
2019	019 Gamification Design for Tourism Mobile Applications Temple 1		
2886	2886 Aerial Object Detection Analysis: Challenges and Preliminary Results 1		
2887 The Performance of DST-Wavelet Feature Extraction for Guitar Chord Recognition			
		•	

	PARALLEL SESSION 3.2.	
	15.00 – 16.10 WIB	
	Room 2 : Magnolia Room	
	Moderator: Dr. Lusia Krismiyati Budiasih	
	<b>Topic :</b> Sustainable Agriculture and Land Use Practices	
2855	Reuse Strategy and Management Models for Abandoned Industrial Areas. A Case	
	Study in Yerevan	10'
2626	Assessing the Effectiveness of Agricultural Policies on Development: A Systematic	
	Literature Review from Diverse Countries	10′
2622	Genetic Variability and Relationship of Agronomic Characters of Soybean Lines In	
	Tidal Swamp Land	10'
2626	Assessing the Effectiveness of Agricultural Policies on Development: A Systematic	
	Literature Review from Diverse Countries	10'
2789	Nutrition Control in Nutrient Film Technique Hydroponic System Using Fuzzy	
	Method	10'
2907	The Inhibitive Effect of Vitamin B2, B6 and Vitamin C on The Cooper Corrosion	10'
2870	Batik Classification Using KNN Algorithm and GLCM Features Extraction	10'



### TABLE OF PAPERS

Page	Paper Id	Title	Author
1	2674	Transparent Carbon Capture and Storage using Blockchain Technology	Gabriela Aristia and Khondaker Salehin
2	2628	Effect of Curing Temperature on The Mechanical Properties of Coconut Shell Nano Carbon Reinforced Composites with Epoxy Matrix	Petrus Iwan and I Gusti Ketut Puja
3	2655	The Role of Nanocatalyst of Pearl Oyster Shell in Pack Carburizing Process on Mechanical and Physical Properties of AISI 1020 Steel	Muhammad Rafi, I Gusti Ketut Puja, and M. Rines Alapan
4	2825	Investigation of Eichhornia crassipes as a natural fibre in PMC for noise controller	Paulina Dwi Nawanti, Dionisius Brian Deva Erwandha, Budi Setyahandana, and I.M.W. Ekaputra
5	2840	Exploring The Potential of Go-Based Composite Hydrogels and Their Swelling Property for Controlled Drug Delivery	Aning Ayucitra and Yi- Hsu Ju
6	2899	Alternative Method for Stop the Coconut Shell Charcoal Briquette Drying Process	Andreas Prasetyadi, Rusdi Sambada, and Petrus Kanisius Purwadi
7	2889	The Effect of Chassis Weight Optimization on The Carbon Footprint of The Electric Prototype Vehicle	Heryoga Winarbawa and Andreas Prasetyadi
8	2671	Utilization of Used Oil Waste for Boiler Energy Source	Akbar Pribadi, Theresia Prima Ari Setyani, Tjendro, Budi Setyahandana, and Martanto
9	2625	Readiness Assessment of Lean Six Sigma Implementation in Manufacturing Industry as A Way To Ensure Sustainability	Fransisca Candra Dewi, Lusia Permata Sari Hartanti, Dian Retno Sari Dewi, Julius Mulyono, and Ig. Jaka Mulyana
10	2659	Modelling study of boiler using oil waste as an energy source	Stefanus Suprianto, Tjendro, Martanto, and Bernadeta Wuri Harini
11	2681	SCADA for Waste Sorting System as an Environmental Conservation Effort	Thomas Eryanto Loblobly and Theresia Prima Ari Setiyani
12	2687	Antibacterial Properties of Enzymatically Treated PET Fibers Functionalized by Nitric Oxide	Nathania Puspitasari, Cheng-Kang Lee, and Chia-Tzu Liu

mmm

13	2843	Design And Feasibility Study of Mobile Biodigester for Military Operation	Aditia Aulia, Akramsyah Reizan Diantomo, Apriliandi Nurhidayat, Naufal Audadi Tanjung, and Syarifah Rodhatul Zakia.
14	2877	Optimization of pyrolysis of polypropylene and polyethylene based plastic waste become an alternative fuel oil using bentonite catalyst	Eunike Desnia, Edwand Rosie, Sandy Budi Hartono, Wiyanti Fransisca Simanullang, Adriana Anteng Anggorowati, and Suratno Lourentius
15	2661	An Overview of Wind Energy to Optimize Initial Potential in Java	Ade Yurika Isti Megawati, Fairusy Fitria Haryani, Sukarmin, Sarwanto, Daru Wahyuningsih, Pujayanto, and Supurwoko
16	2666	Solar Power Control System on Smart Green Home	David Adhi Supriyanto Putra, Bernadeta Wuri Harini, Regina Chelinia Erianda Putri, and
			Petrus Setvo Prahowo
17	2663	Numerical Investigation on the Effect of Blunt Body Deflector on Darieus Turbine Performance	Ahmad Syafiq Rofi'i, Aditia Aulia, Muhammad Ferry Fadri, Muhammad Haidar
			Rahman, and Gunawan
18	2773	Using A Stepper Motor as A Low-Power, Low- Rotation DC Generator for Renewable Energy Harvesting	Djoko Untoro Suwarno
19	2786	Design And Implementation of A 232.2 KWP Rooftop and on Grid Solar Power Plant	Rasional Sitepu, Andrew Joewono, Yuliati, Peter R. Angka, and Brian Teja
20	2812	An experimental investigation on CCFL characteristics during gas/low surface tension liquid counter-current two-phase flow in a small-scaling PWR hot leg typical geometry	Achilleus Hermawan Astyanto, Dede Rafico Saleh, Indarto, and Deendarlianto
21	2830	Techno-Economic Analysis of Hybrid PV-Battery- Diesel System for Isolated Dockyard in West Papua	Azis Saputra, Aji Setyawan, Chairiman, Adinda Ihsani Putri, and Lina Java Diguna

......

22	2876	Machine Learning Based Modelling for Estimating	Nur Uddin, Edi Purwanto, and Hari Nugraha
23	2816	Aerodynamic Analysis of a Windmill Water Pump using Blade Element Momentum Theory	M N Setiawan, Harry Ramadhan, A Michelle Sutopo, and Zulkan
24	2983	Coefficient of Power of Indonesian Traditional Wind-Pump Blade Model	Albertus Naturally Baskoro, YB. Lukiyanto, Dionisius Brian Deva Erwandha, and Rines
25	2680	Fast fashion Revolution: Unveiling the Path to Sustainable Style in the Era of Fast fashion	Tiara Nur Anisah, Andika Andika, Danang Wahyudi, and Bimo Harnaji
26	2344	The Impact Assessment of Automated Drip Infusion Control Using Weighing Scale and Pinch Method on Subjects	Lanny Agustine, Made Indra Ayu Astarini, Maria Manungkalit, Jose Amadeus, and Hartono Pranjoto
27	2635	Analysis of Coal Facies and Parting in The Balikpapan Formation, Kutai Basin, East Kalimantan	Roni Fauzan, R.A.T. Listyani, and Setyo Pambudi
28	2637	Distribution Model, Depositional Environment, and Facies Of Coal in the AE field, Kutai Kartanegara area, East Kalimantan	Taufiq Erlangga Sutedjo, Setyo Pambudi, R.A.T. Listyani, and Oky Sugarbo
29	2682	A Method for Assessing Green Value Chain Readiness	Ivan Gunawan, Dian Trihastuti, Lusia Permata Sari Hartanti, and Ivan Keane Hutomo
30	2779	Study of Population Distribution and Benefits of Nipah (Nypa fruticans)	Syaiful Eddy, Mirna Taufik, Andi Arif Setiawan, Budi Utomo, and Maharani Oktavia
31	2795	Development of Digital Livestock Monitoring in Sambilawang Village, Serang, Banten	Sesaria Kikitamara, Izzahtul Mujahidah, and Permata Nur Miftahul Rizky
32	2817	Comparison of the K-Means Method with and without Principal Component Analysis (PCA) in Predicting Employee Resignation	Iwan Binanto and Andrianto Tumanggor
33	2844	The Key Impact Factors of Visitors' Environmentally Responsible Behaviour at Mlarangan Asri Beach Kulon Progo Regency	Erni Ummi Hasanah, Yumarlin MZ, Retno Lantarsih, Iwan Aminto Ardi, Danang Wahyudi, Andika, and Della Nanda Luthfiana

34	2878	Environmental Management for Car Accident Precaution and Remote Notification	Gerardo Reinaldy, Peter Rhatodirdjo Angka, Albert Gunadhi, Yuliati, and Rasional Sitepu
35	2905	Replication Control Strategy Based on A Simple Game of Life in Opportunistic Mobile Networks	Vittalis Ayu, Bambang Soelistijanto, and Yasintha Putri Larasati
36	2019	Gamification Design for Tourism Mobile Applications Temple	Yurri Rolly Wagiu, Andi W.R. Emanuel, and Pranowo
37	2879	Fall Detection and Notification System to Fast Emergency Management for the Elderly	Ivan Goldwin, Albert Gunadhi, Diana Lestariningsih, Peter Rhatodirdjo Angka, and Lanny Agustine
38	2883	Classification of Delivery Types of Pregnant Women Using Support Vector Machine	Maria Yubela Chelsea and Paulina H. Prima Rosa
39	2885	A Study of Stochastic Epidemic Model Driven by Liouville Fractional Brownian Motion Coupled with Seasonal Air Pollution	Herry Pribawanto Suryawan
40	2886	Aerial Object Detection Analysis: Challenges and Preliminary Results	Agnes Maria Polina, Hari Suparwito, and Rosalia Arum Kumalasanti
41	2887	The Performance of DST-Wavelet Feature Extraction for Guitar Chord Recognition	Linggo Sumarno
42	2855	Reuse Strategy and Management Models for Abandoned Industrial Areas. A Case Study in Yerevan	Astghik Grigoryan, Zara Manvelyan, and Emilya Sargsyan
43	2626	Assessing the Effectiveness of Agricultural Policies on Development: A Systematic Literature Review from Diverse Countries	Tidiane Guindo and Muhamad Bai'ul Hak
44	2622	Genetic Variability and Relationship of Agronomic Characters of Soybean Lines In Tidal Swamp Land	Heru Kuswantoro
45	2789	Nutrition Control in Nutrient Film Technique Hydroponic System Using Fuzzy Method	Augustinus B. Primawan and Novadi D.L. Kusuma
46	2907	The Inhibitive Effect of Vitamin B2, B6 and Vitamin C on The Cooper Corrosion	Hartono Pranjoto, Adriana Anteng Anggorowati, Andrew Joewono, Lourentius Suratno, and Adi Candra
47	2870	Batik Classification Using KNN Algorithm and GLCM Features Extraction	David Wijaya and Anastasia Rita Widiarti



### Comparison of the K-Means method with and without Principal Component Analysis (PCA) in predicting employee resignation

Iwan Binanto<sup>1\*</sup> and Andrianto Tumanggor<sup>1</sup>

<sup>1</sup>Informatics Department, Faculty of Science and Technology, Sanata Dharma University, Yogyakarta, Indonesia

Abstract. Employees are individuals who work for a company or organization and receive a salary. Employees are the most important assets that need to be effectively managed by the company in order to maximize their contribution. However, many employees feel dissatisfied with the outcomes of their contributions to the company, as they do not receive the expected rewards. This study utilizes a dataset from Kaggle.com, consisting of a total of 14,999 data rows with 10 attributes. In the first experiment, the dataset was reduced using PCA before applying the K-means clustering method. In the second experiment, the dataset is directly fed into the Kmeans clustering method without PCA. To evaluate the clusters in the Kmeans method, this study applies the sum of squared error (SSE) method and the silhouette coefficient method to determine the optimal clusters. The study concludes that there are two dominant factors, last evaluation and average monthly hours, that contribute to employees resigning from a company. The SSE evaluation indicates that both methods have an elbow point at 3 clusters, suggesting that dividing the data into more than 3 clusters does not provide significant additional information. The silhouette coefficient evaluation shows that K-means without PCA obtain the best silhouette coefficient value of 0.5674, while K-means with PCA obtain a silhouette coefficient value of 0.5491. Although K-means with PCA have the advantage of reducing the dimensionality of the dataset, they have a longer execution time compared to K-means without PCA, with an execution time of 181.53 seconds for K-means with PCA and 95.84 seconds for K-means without PCA.

#### 1 Introduction

Employees are assets and the main elements in an organization, playing a crucial role in achieving the organization's goals [1]. The success of a company depends on its employees as human resources [2]. Therefore, a company must be capable of managing its human resources or employees who have a strong commitment to the sustainability and progress of the organization or business. However, managing employees is not easy because employees

<sup>\*</sup> Corresponding author: iwan@usd.ac.id

<sup>©</sup> The Authors, published by EDP Sciences. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

cannot be equated with factory tools or machines; each of them has different thoughts, feelings, positions, desires, and backgrounds from others [3].

Employees who resign can have serious consequences for the company, such as economic impacts. The economic impact on the company includes the cost of training new employees [4]. Although there are still employees who remain loyal to the company with high levels of satisfaction. Therefore, an analysis of the reasons for employee resignations is needed. The causes here are the factors that influence them.

Avinash Navlani discovered that the factors influencing employees to resign from a company are low job satisfaction, low promotion opportunities, low salary, and working longer hours compared to those who stay in the company [5]. Therefore, it is important for the company to understand what factors influence employees' decisions to resign and seek ways to reduce the resignation rate. These factors were identified by applying the K-means method by grouping the most dominant attributes.

However, in high-dimensional data clustering, conventional K-means algorithms are susceptible to data with large attributes, leading to the "curse of dimensionality" [6]. Reducing dimensions also means reducing data complexity. To address this issue, dimensionality reduction of data is necessary. One of the methods used for dimensionality reduction is the PCA method.

This research will compare the results of the K-means method with Principal Component Analysis (PCA) and compare the results of the K-means method alone. The aim of this comparison between the two methods is to determine the most optimal method for predicting employees who will resign from a company. Both the K-means method and the PCA method are commonly used clustering methods in research [7].

In this research, data sourced from kaggle.com, which was published in 2018 [8], will be used. This study focuses on the use of clustering methods by applying the K-means method with and without PCA to predict resigning employees. The author will test which factors are most dominant in causing employees to resign, as well as the most optimal number of clusters in the dataset, and which is better between K-means with PCA and K-means without PCA in clustering this dataset. Cluster evaluation processes will use the Sum of Squared Error (SSE) and Silhouette Coefficient.

#### 2 Literature reviews

Avinash Navlani predicted resigning employees using the K-means clustering method with a obtained k = 3 and the dataset used was from Kaggle.com. By applying the Gradient Boosting Classifier model, he achieved an accuracy of 97%, a precision of 95%, and a recall of 92% [5].

Ainun Umami conducted a Classification of Factors Influencing Employee Reduction at "XYZ" Company using the Naïve Bayes, SVM, Logistic Regression, MLP, Gradient Boosting, KNN, Random Forest, and Decision Tree methods. The data used was the IBM HR Analytics Employee Attrition & Performance Dataset downloaded from Kaggle. After analysis, the best classification methods were found to be Naive Bayes, SVM, Logistic Regression, and MLP [9].

Susanti and Palupiningdyah conducted research on the direct and indirect effects of job satisfaction, organizational commitment, and turnover intention on employee performance, mediated by turnover intention. This study used a sample of 82 out of 144 employees. Based on the hypothesis testing results, it can be concluded that job satisfaction and organizational commitment have a negative and significant impact on turnover intention. Job satisfaction and organizational commitment have a positive and significant impact on employee performance, and turnover intention has a negative and significant effect. The impact on

employee performance and turnover intention can convey the influence of job satisfaction and organizational commitment on employee performance [2].

The calculation of the Sum of Squared Error (SSE) is performed to determine the optimal number of clusters by analyzing the comparison between the number of clusters and the inertia values generated on a graph, and finding the point on the graph where the decrease in inertia value significantly slows down, forming an "elbow" at that point [10]. The K-means clustering algorithm has limitations in determining the optimal number of clusters out of n trials. However, SSE can help overcome this weakness and improve the quality of the model generated by the K-means algorithm [11]. Therefore, to address the limitations of this coefficient method, Kneelocator is applied. Kneelocator functions to dynamically determine the optimum K value based on the application of SSE [12].

#### **3 Research method**

In general, the research method is depicted in Figure 1.



Fig. 1. Diagram of research method.

#### 3.1 Data analysis

No	Attribute	Description	
1	Satisfaction_level This is the point of employee satisfaction, which ranges from 0 to 1.		
2	<i>last_evaluation</i> This is the performance evaluated by th employer, which also ranges from 0 to 1.		
3	number_projects How many projects are assigned to an employee?		
4	average_monthly_hours What is the average number of working hours fo an employee in a month?		
5	time_spent_company	Employee experience. The number of years spent by an employee in the company.	
6	work_accident	Has an employee ever experienced a work accident or not?	
7	promotion_last_5years	Has an employee received a promotion in the last 5 years or not?	
8	Departments	Employee's division.	
9	Salary         Employee salary levels: low, medium, and high		
10	Left	Has the employee left the company or not?	

 Table 1. Attribute and description.

The dataset used in the study consists of 14,999 rows and 10 attributes. The required attributes for this research include: satisfaction\_level, last\_evaluation, number\_project, average\_monthly\_hours, time\_spend\_company, work\_accident, left, promotion\_last\_5years, departments, and salary.

The data is stored in comma-separated value (CSV) format. String-type attributes will be converted into numeric values to facilitate the reduction and clustering processes. Data details can be seen in Table 1.

#### 3.2 Preprocessing

This stage is a step for cleaning, standardizing, and normalizing the data so that the data is ready for processing.

This dataset is actually intended for classification, so the target attribute needs to be removed to make this dataset suitable for clustering. Fortunately, there are no missing values in this dataset, so no data needs to be deleted. Non-numeric attributes are converted to enable normalization and standardization.

Additionally, a data correlation process is performed to determine the relationships between variables. The aim is to facilitate data clustering. The correlation method used is the Pearson correlation. The results can be seen in Figure 2.



Fig. 2. Visualisation correlation.

Based on the correlation calculation above, there are two variables that have a significant impact based on the correlation scores obtained, namely last\_evaluation and average\_monthly\_hours. Both of these variables will be used in the K-means clustering visualization.

#### 3.3 Processing

The data that has been prepared is then processed using K-Means only, as well as a combination of PCA and K-Means.

#### 3.3.1 K-Means only

In this stage, the K-means method is implemented without dimension reduction. The dataset, which has already been normalized and standardized, is processed using K-Means alone. The results are visualized as shown in Figure 3.



Fig. 3. Cluster visualisation k-means only.

From the visualization, it is evident that the density is quite high, and there is a cluster that is denser than the others, which is the cluster on the left side.

#### 3.3.1 PCA and K-Means

In this stage, the K-means method is implemented with PCA for dimension reduction of the data before clustering. PCA is used to reduce the data dimensions while retaining significant information from the original data. The result of implementing PCA on the dataset is the reduction of dataset attributes to 8 attributes, namely satisfaction\_level, last\_evaluation, number\_project, average\_monthly\_hours, time\_spent\_company, work\_accident, promotion\_last\_5years, and departments. These eight attributes will be processed using K-Means. The result can be seen in Figure 4.



Fig. 4. Cluster visualisation PCA with K-Means.

From the visualization, it can be seen that the density is quite high and more evenly distributed.

#### 3.4 Evaluation

In this stage, clustering evaluation is conducted to determine the quality of the clustering results that have been obtained. Evaluation is carried out to assess how well the clustering method can group data and minimize variance between clusters. Evaluation can also assist in determining the optimal number of clusters and evaluating the effectiveness of the features used in the clustering process.

In this research, two clustering evaluation metrics are used to determine the value of k in the K-means clustering method, namely the Sum of Squared Error (SSE) and the Silhouette Coefficient.

#### 3.4.1 K-Means only

To facilitate the visualization of SSE, the Elbow method is used to find the "elbow" point on the curve, which represents the point of diminishing returns or the optimal number of clusters. The result is visualized by plotting SSE against the number of clusters, with a vertical line indicating the elbow point. The plot helps visualize the "elbow" point and observe the SSE trend as the number of clusters increases. The result can be seen in Figure 5.



Fig. 5. Elbow visualisation K-Means only.

In this visualization, it can be seen that the optimal number of clusters is 3.

For n\_clusters = 2, the silhouette score is 0.5541 For n\_clusters = 3, the silhouette score is 0.5674 For n\_clusters = 4, the silhouette score is 0.4362 For n\_clusters = 5, the silhouette score is 0.4003 For n\_clusters = 6, the silhouette score is 0.3557 For n\_clusters = 7, the silhouette score is 0.3388 The best k value is 3 with a silhouette score of 0.5674 0.55 Silhouette Coefficient 0.50 0.45 0.40 0.35 2 з 5 6 Number of Clusters



Then, the Silhouette Coefficient is calculated to also aid in determining the optimal number of clusters based on the maximum point on the graph because the number of clusters with the highest Silhouette Coefficient value indicates the best number of clusters for separating the data into different groups. The result can be seen in Figure 6.

In above visualization, the highest score is observed at the number of clusters 3.

#### 3.4.2 PCA and K-Means

Just like the previous stage, in this stage, the Elbow method is also applied. The result is as shown in Figure 7.



Fig. 7. Elbow visualisation PCA with K-Means.

In above visualization, the highest score is observed at the number of clusters 3. Then, the Silhouette Coefficient is also calculated. The results can be seen in Figure 8.





In the visualization above, the highest score is observed at the number of clusters 3.

#### 3.5 Results

The experimental results can be summarized as shown in Table 2.

~~~	Cluster	Silhouette Coefficient	
SSE		K-means with PCA	K-means
	2	0.5315	0.5541
	3	0.5491	0.5674
Coeffisient	4	0.4248	0.4362
clusters	5	0.3919	0.4003
	6	0.3488	0.3557
	7	0.3334	0.3388
Execution Time		181.539 seconds	95.843 seconds

Table	2.	Ext	periment	results.
ant		LA	perment	results.

#### 4 Discussions

The SSE evaluation indicates that both methods have an elbow point coefficient at 3 clusters, indicating that dividing the data into more than 3 clusters does not provide much additional information.

The Silhouette Coefficient evaluation indicates that both K-means with and without PCA have relatively similar Silhouette Coefficient values for 3 clusters. However, K-means without PCA achieves the best Silhouette Coefficient value, which is 0.5674.

The execution time for K-means with PCA is longer compared to K-means only. The execution time obtained from the K-means with PCA method is 181.53 seconds, while the execution time obtained from the K-means only method is 95.84 seconds.

#### **5** Conclusions

From the obtained data correlation results, it can be concluded that there are two factors that are most dominant in causing employees to resign, namely *last\_evaluation* and *average\_monthly\_hours*.

The difference in execution time between processing with K-Means only and PCA with K-Means is quite significant, so in this case, we recommends using K-Means only for clustering.

#### References

- 1. B. Usman, J. Media Wahana Ekon. 17, 18 (2020)
- 2. S. Susanti and P. Palupiningdyah, Manag. Anal. J. 5, (2016)
- 3. Handoko, Manajemen Personalia & Sumber Daya Manusia. Manajemen Personalia & Sumber Daya Manusia., Edisi 2. (BPFE, Yogyakarta, 2001)
- 4. R. K. Sari, H. F. Fajar, R. B. Rizqi, and R. A. Putra, ISOQUANT J. Ekon. Manaj. Dan Akunt. **3**, 45 (2019)
- 5. A. Navlani, (2018)

- R. Laraswati, M. I. Jambak, and D. Rodiah, Perbandingan Teknik Reduksi Dimensi Antara Algoritma Principal Component Analysis Dengan Fuzzy Association Rule, 2020
- 7. M. Herlambang, (2019)
- 8. Kakisama, (2018)
- 9. A. Umami, Acad. Journal, Surabaya 4 (2018)
- 10. N. H. Harani, C. Prianto, and F. A. Nugraha, J. Manaj. Inform. 10, 133 (2020)
- 11. M. Billah, M. A. Zartesya, and D. S. Prasvita, in *Semin. Nas. Mhs. Ilmu Komput. Dan Apl.* (2021)
- 12. A. W. A. Ruslam, (2021)

# Thank you for your

# extraordinary contribution to

International Conference on Applied Sciences and Technologies (InCASST)



